



Original Communication

Fatal unintentional injuries among young children – A hospital based retrospective analysis[☆]

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ABSTRACT

Unintentional (accidental) injuries in childhood constitute a significant public health problem. Young children are extremely vulnerable to unintentional injuries that are vastly preventable. All cases of fatal unintentional injuries in children aged 10 years and below autopsied during 1994–2007 were retrospectively reviewed. Seventy five such cases were identified during the 14 year study period. Males accounted for 68% of cases with a male–female ratio of 2.1:1. Mean age of male and female victims was 5.3 and 4.9 years, respectively. Road traffic fatalities accounted for majority of the cases in this age group (52%), followed by those due to thermal injuries (22.7%). Flame was the cause of thermal injuries in 52.9% cases and scalds were observed in 47.1% cases. Traffic fatalities, fall and drowning were more common in school age children while toddlers and pre-school age children were relatively at a greater risk from domestic accidents (thermal injuries and poisoning). The most frequent victims of road traffic incidents were pedestrians (64.1%). Head injuries alone were the cause of fatalities in the majority of road traffic incidents (82.1%). The study highlights on the pattern of fatalities due to unintentional injuries among young children. To reduce the burden of unintentional childhood mortalities in this region, priorities for school age children are traffic injuries and for toddlers and pre-school children, thermal injuries.

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1. Introduction

Worldwide about 3.5 million people die of unintentional (accidental) injuries every year and 25% of the global accidental deaths are estimated to occur in the South East Asia region.^{1,2} Unintentional (accidental) injuries in childhood constitute a significant public health problem and have been considered as ‘the last major plague of the young’.³ Children in the first decade of life are extremely vulnerable and need adult care and guidance. They are exposed to both natural (medical) and unnatural (accidents, suicides or homicides) fatal conditions. Death attributable to medical conditions are likely to be considered preventable while deaths attributable to unintentional injuries are vastly preventable.

Kasturba hospital is the apex teaching hospital of Kasturba Medical College, Manipal situated in Udupi District of coastal Karnataka in southern India. The pattern of unnatural deaths in children and adolescents in this region has been previously

addressed.⁴ A brief report on the problem status of accidental childhood fatalities⁵ has prompted the authors to take up this research in detail, with a comparison with studies done elsewhere in India and abroad. This hospital based retrospective study aims at a detailed description of the pattern and trend of accidental deaths in young children aged 10 years and below, in Manipal during 1994–2007, that may help in recognition of vulnerable groups for development of strategies to prevent such mortalities.

2. Material and methods

This study is a registry based detailed descriptive retrospective research that was carried out in the Department of Forensic Medicine, Kasturba Medical College, Manipal. All medicolegal autopsy case records from January 1994 to December 2007 were retrospectively reviewed and deaths among young children aged 10 years and below were analysed.

Medicolegal autopsies are performed as per the law of the land towards administration of justice. In India, manner of death in all cases of fatal unintentional injuries is designated as accidental. Such cases are recorded as unnatural and autopsy is performed. Medicolegal autopsies in India are carried out on requisition by

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the police or the magistrate with a primary aim to reveal the cause of death and to decide if the cause of death is in accordance with the postulated manner of death. All cases identified as accidental in manner by the autopsy surgeons and the police investigating officers in their inquest after preliminary investigations into the incident were included in the study. Deaths due to suicidal and homicidal manner were excluded. The information obtained from autopsy and police investigation records was registered in a database and analysed using the statistical software (SPSS version 11.0).

3. Results

In the 14 years (1994–2007), that the study spanned, 75 cases of fatal unintentional injuries were identified in children aged 10 years and below. This amounted to 3.4% of total cases autopsied ($n = 2181$) during the study period. Of the 75 fatalities, 68% victims ($n = 51$) were males and 32% ($n = 24$) were females. Overall male–female ratio was found to be 2.1:1. Mean age of male and female victims was 5.3 and 4.9 years, respectively. Although overall age distribution was fairly uniform, maximum victims ($n = 11$) were aged 1 year. Age distribution of male and female victims is shown in Fig. 1. Road traffic fatalities accounted for 52% of total accidental deaths ($n = 39$) followed by death due to thermal injuries; burns and scalds (22.7%, $n = 17$). Other causes of childhood mortality included drowning (10.7%), poisoning (9.3%) and falls (5.3%). Male–female ratio for individual cause of fatal unintentional injuries differed from one another. Male–female ratio was maximum for drowning and fatal falls, and minimum for death due to thermal injuries. Gender wise distribution of the victims for all causes of fatal unintentional injuries during the study period is shown in Table 1. Traffic fatalities, fall and drowning were more common in older group (children of school age; 5 years and above), while toddlers and pre-school age children (below 5 years) were relatively at a greater risk from domestic accidents (thermal injuries and poisoning). Mean age for individual causes is shown in Fig. 2. Nearly 70% ($n = 26$) of the total fatalities from road traffic injuries were seen in children aged 5 years and above, while 70.6% ($n = 12$) vic-

Table 1

Gender-wise distribution of cause of fatal unintentional injuries.

Cause	Male (n, %)	Female (n, %)	Total (n, %)	M:F
Traffic injuries	28, 54.9	11, 45.8	39, 52.0	2.5:1
Thermal injuries	09, 17.6	08, 33.3	17, 22.7	1.1:1
Drowning	06, 11.8	02, 08.3	08, 10.7	3:1
Poisoning	05, 09.8	02, 08.3	07, 09.3	2.5:1
Falls	03, 05.9	01, 04.2	04, 05.3	3:1
Total	51, 100	24, 100	75, 100	2.1:1

tims of thermal injuries were aged below 5 years. All victims of fatal scalds were aged below 5 years (6 months to 4.5 years). For flame burns, 44.4% ($n = 4$) victims were aged between 6 months and 1.5 years, and other 5 victims were aged more than 5 years.

On autopsy, head injuries alone were diagnosed to be responsible for the fatal outcome in 82.1% ($n = 32$) cases of road traffic incidents. Head injuries along with thoracic injuries ($n = 1$), head injuries along with thoraco-abdominal injuries ($n = 1$), thoracic injuries ($n = 1$), abdominal injuries ($n = 1$), thoraco-abdominal injuries ($n = 2$), and pneumonia ($n = 1$) were the other causes of death. Maximum victims in road traffic incidents were pedestrians (64.1%). Details of road traffic incident based on initial police investigations are shown in Table 2.

Flame was the cause of thermal injuries in 52.9% cases ($n = 9$) and scalds were observed in 47.1% cases ($n = 8$). Liquid paraffin (kerosene) was the accelerant and kerosene lamp was responsible for majority of the cases (87.5%, $n = 7$) of flame burns; one girl child accidentally fell in fire while playing whereas in one case exact cause of flame burns was not available in records. Scalds resulted secondary to spillage of boiling rice water ($n = 3$), hot water ($n = 2$), oil ($n = 1$), milk ($n = 1$) and sambhar, an Indian traditional dish ($n = 1$). Mean total body surface area involved was 57.4% (20–80%) in flame burns and 52.6% (40–90%) in scalds. Mean period of survival in cases of flame burns and scalds was approximately nine days. Septicemia was responsible for majority of the fatalities (70.6%, $n = 12$) in cases of thermal injuries.

Among other causes, 62.5% ($n = 5$) of the drowning victims were aged 6 years and above. Two boys (brothers) drowned in a river

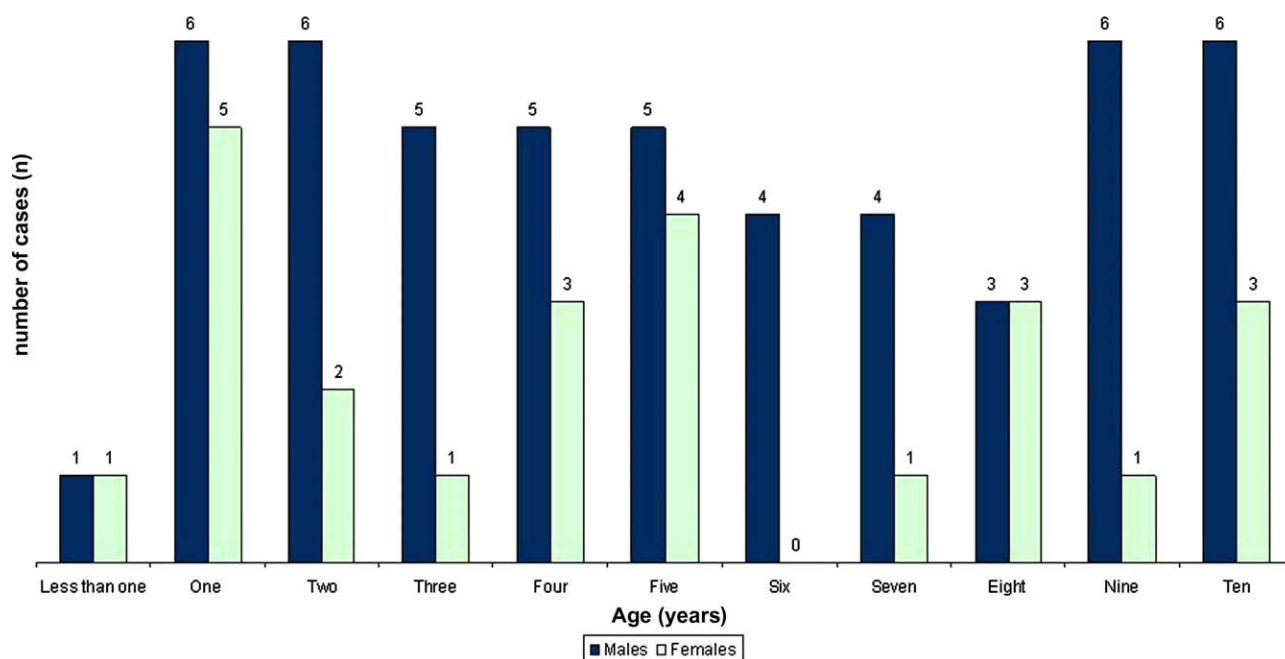


Fig. 1. Age distribution of fatal unintentional injuries in children.

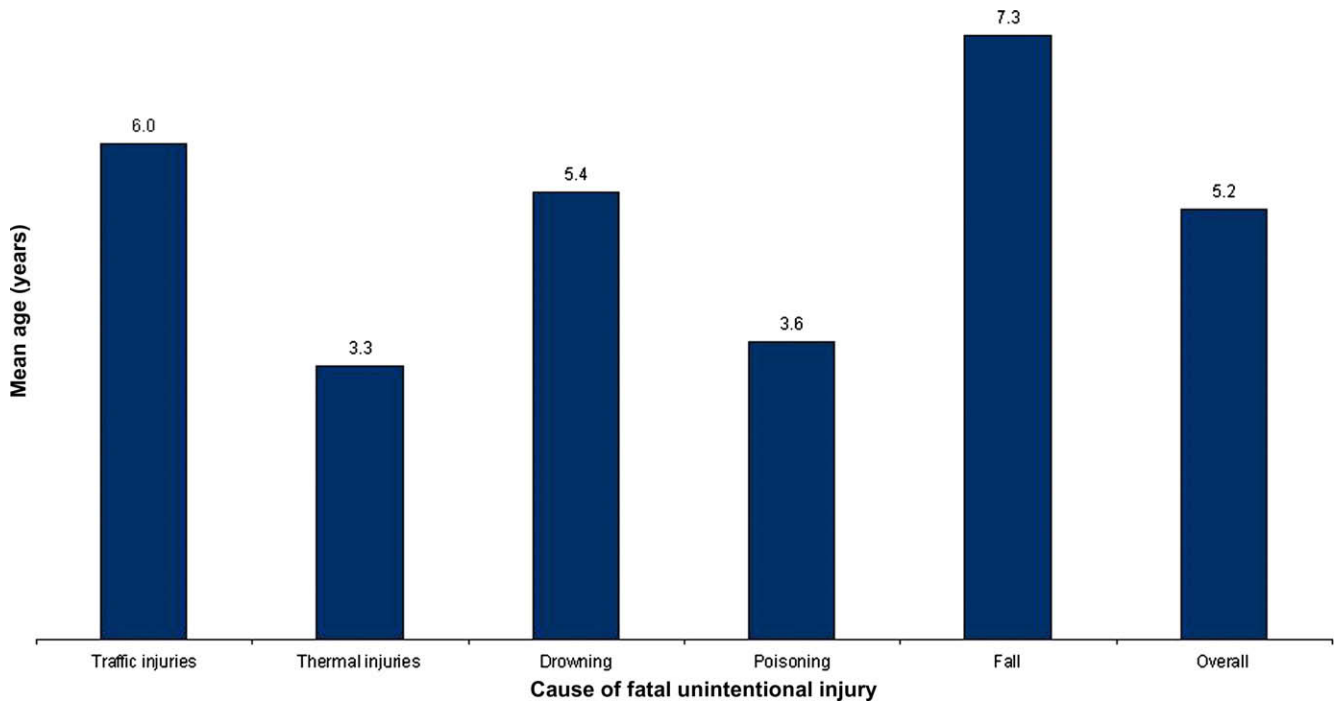


Fig. 2. Mean age for each cause of fatal unintentional injuries in children.

while taking bath, one while swimming in a river, one in a canal and one fell into a well. Other three victims were aged 2 years and below; two among them fell in a water tank ($n = 2$), and the other in a cow dung pit ($n = 1$) while playing. Majority of the victims (62.5%, $n = 5$) were recovered dead from the water source, while the rest survived for 2–4 days and died of respiratory complications. All victims of accidental poisoning except one (a girl aged 8 years) were aged 4 years and below. Poison could not be identified in two cases and the regional forensic science laboratory report was not made available as yet. Agrochemicals were responsible for the fatal outcome in three cases (organophosphates-2, organochlorines-1) and corrosive acid (sulphuric acid) in one case. All three male victims of fall were aged between 8 and 10 years, and fell from trees (height of fall approximately ranged from 8 to 15 feet). The only female victim of fall was aged 2 years and fell

from her grandfather's lap. Three of the four victims died of head injuries; other one suffered from fracture dislocation of 2nd to 4th cervical vertebrae. All four cases of fatal falls were reported in outdoor settings and were witnessed incidents.

4. Discussion

The health problems encountered by the developing world pediatric population comprise mainly of low birth weight, malnutrition, infections, accidents and poisoning, whereas in the developed world, accidents and poisoning are a relatively more important health problem. The leading causes of death in the below 5 years age group in the developing countries are diarrhoea and respiratory infections followed by communicable diseases and accidents. In the developed world, however, unintentional injuries are the leading cause of death in children aged 1 year and above. Studies in the US have shown that the leading cause of death in children less than 10 years of age was an unintentional injury. The number of accidental deaths of children, aged 5–9 years, almost equaled the number of deaths from natural causes.⁶

The number of deaths of male children was almost twice as compared to female children during the study period, similar to other studies that confirm this male predominance.^{3,7–14} Majority of the fatal unintentional injuries in young children were attributed to traffic incidents, burns and scalds. Highest proportion of traffic fatalities in our study is similar to studies from other parts of the world.^{3,7–12,15,16} Most of the victims of traffic injuries were pedestrians. Trauma to the head remained the leading cause of death in childhood traffic injuries stressing on the importance of head injury as a cause of childhood fatality. Our findings are in agreement with studies from other parts of the world.^{7–9,15} Larger and heavier cranial vault in relation to total body mass and less myelinated brain in children predisposes them to high degrees of torque and shearing forces. Thermal injuries from flame burns and scalds were the second most common cause of accidental fatalities in young children in our study. Liquid paraffin (kerosene)

Table 2

Details of road traffic incident based on initial police investigations^a.

Victim	Offending vehicle	Number of cases (n)
<i>Vehicular passenger (n = 13, 33.3%)</i>		
Tempo	Bus	04
Car	Bus	02
Car	Lorry	02
Bus	None (toppled)	02
Jeep	None (toppled and fell in lake)	01
Car	None (hit a tree)	01
Motorcycle	None (pillion rider fell from it)	01
<i>Pedal-cyclist (n = 01, 2.6%)</i>		
Pedal-cyclist	Motorcycle	
<i>Pedestrian (n = 25, 64.1%)</i>		
	Two wheeler	05
	Auto	03
	Car	05
	Van	02
	Tempo/good's carrier	05
	Bus	05

^a This being a retrospective study, exact cause and liability of road traffic incident was not established at the time of autopsy.

was the accelerant and kerosene lamp was responsible for majority of the cases of flame burns. Frequent use of kerosene lamps in rural India is probably responsible for fire related deaths in young children. Owing to their potential of long term anatomical and physiological disability, burns and scalds are important issues in developing preventive strategies.¹⁷ All victims of fatal scalds were aged between 6 months and 4.5 years. Children are more vulnerable to fatal outcome in burn injuries when compared to their adult counter-parts owing to larger body surface area relative to body weight that results in significantly high rates of heat loss due to evaporation. In our study, majority of the victims of thermal burns died of septicemia. Unsafe behaviour of child and lack of adult supervision is possibly responsible for majority of such accidental fatalities.

Airway obstruction from choking, suffocation and strangulation is the second leading cause of accidental death in Kansas children and a serious problem in the US¹⁸ Accidental choking and suffocation was responsible for majority of infant deaths in New Zealand³ and South Africa.¹⁴ Besides, fatal unintentional traumatic asphyxia has also been reported in childhood.¹⁹ In our study, however, drowning was the only observed cause of accidental asphyxia in the region. Drowning was one of the major areas of concern similar to other studies worldwide.^{3,10,11,13,14,16,20} Drowning victims were aged 2 years and below, and 6 years and above. Drowning fatalities were thus concentrated among toddlers (indoor settings) and school age children (outdoor settings).

Lesser number of fatal unintentional poisonings in our study is in accordance with other studies in the Indian sub-continent and Europe.^{21–25} Of the four identified cases of fatal poisonings, agrochemicals were responsible for fatal outcome in three cases. India is predominantly an agriculture based country, and use of agrochemicals, predominantly organophosphate compounds in this part of rural India is frequently responsible for these accidental poisoning deaths. Accidental poisoning is the 12th leading cause of admissions in pediatric wards in India and accounts for 1% of hospitalized patients. As children start crawling and walking around the age of 1 year, they become active and try to explore unfamiliar objects by putting them into their mouth and tasting them, thus exposing them to accidental poisoning. In large Indian families, mother is too occupied with household chores, easily fatigued and often careless in storage of potentially poisonous household substances.²⁶ Poison stored in easily accessible places expose children to greater risk of poisoning.

In our study, all male victims of fall were aged between eight and 10 years, who slipped and fell from trees. The only girl child aged 2 years fell from her grandfather's lap. Reliability of the history of fatal falls in young children is often questioned especially in low level falls. Long falls with an outdoor component are likely to be reliable data points.²⁷ All four cases of fatal falls in our study were low level falls, reported in outdoor settings and were witnessed incidents. Predominance of fatal low level falls and male victims seen in our study is similar to that reported in an earlier study.²⁸ Head injury was the major cause of fatal outcome in children similar to other reports.^{28,29} Higher incidence of fatal intracranial injuries has been reported in children who fell less than 15 feet than those who fell more than 15 feet.³⁰

The incidence of fatal unintentional road traffic injuries was higher among the males when compared to females among toddlers, pre-school and school age children. Fatal road traffic injuries doubled from below 5 years age group to the 5 years and above group. The literature from other parts of India and world confirms our observation.^{7,8,31–33} Children aged less than 5 years were relatively at a greater risk at home with death from thermal injuries and poisoning predominating. Thermal injuries remain a serious problem in children below 5 years, similar to a study done in Ohio, where fire was the leading cause of injury fatality for metropolitan

children aged one to 5 years.¹⁶ Relatively higher female fatalities and thus lower male–female ratio among young children in death due to burns, found in our study is suggestive of the fact that females are relatively more exposed to fire in India. In our study, drowning and fall were more common in school age children. Contrary to our findings, falls were commonly observed cause of childhood mortalities in the below 5 years age group in UAE⁸ and drowning in Australia.⁷ Children below 5 years are confined to indoors while their older counter-parts are more exposed to outside world and traffic. Difference in surroundings and exposure of children of various age groups is responsible for this apparent change in fatality pattern of children.

5. Conclusions

Unintentional (accidental) injury in young children is a significant problem. The study highlights the magnitude and pattern of mortalities from such injuries among young children in Manipal, Southern India:

- Male children are recognized as the vulnerable group accounting for 69.3% of the total fatalities.
- Road traffic injuries and thermal injuries together accounted for 72.5% fatalities in males and 79.1% fatalities in females.
- Females were relatively more prone to thermal injuries and males to traffic injuries.
- Road traffic incidents, fall and drowning were more common in older children, while thermal injuries and poisoning in younger children.
- Head injuries were the most common cause of fatal outcome in road traffic incidents and falls, and septicemia in thermal injuries.

The overall trend of fatalities from unintentional injuries was quite similar to other parts of the world. Global problem in this regard remains the same irrespective of the difference in topography and demography of the region. In terms of theoretical potential to reduce the total injury fatality rate, priorities for school age children are road traffic fatalities and for toddlers and pre-school age children, death resulting from thermal injuries.

Conflict of interest statement

The authors have no conflict of interest to declare.

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Ethical approval

None declare.

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